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ANTI-PREDATOR RESPONSES OF SHARP-SHINNED HAWKS

by

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Abstract

Migrating Sharp-shinned Hawks (*Accipiter striatus*) aggressively approached a Great Horned Owl (*Bubo virginianus*) model. Components of the approach included a silent flight devoid of wing motion, vocalizations, use of tarsi, multiple approaches and avoidance of the front of the model. These components were manifested in different combinations and frequencies. It is suggested that the function of attacking by this species is to drive off a larger predator and that predation upon this species by other raptors is probably more common than reported in the literature.

Introduction

In birds, anti-predator behavior such as mobbing has been studied mostly among passerine species (Curio 1975; Hartley 1950; Hinde 1954; Nice & ter Pelkwyk 1941; Smith & Graves 1978). Mobbing has been defined as a demonstration made by a bird against a potential or supposed enemy of a more powerful and dangerous species (Hartley 1950). It is manifested by aggressive approaches toward the stimulus object and also alert calls while the mobbers perch near the predator. The term "mobbing" is generally used to describe anti-predator behavior by groups and controversy arises when applying it to action by an individual. Many passerines are either members of family groups in the nesting season, or mixed species or intraspecific flocks during the remainder of the year. Many non-passerines, including raptors, are relatively asocial during the non-breeding season and yet, they engage in behavior similar to the mobbing of passerines when a predator is recognized. Anti-predator behaviors in these species have not been systematically investigated. In the present study we describe anti-predator behavior of immature and adult Sharp-shinned Hawks (*Accipiter striatus*) directed toward a Great Horned Owl (*Bubo virginianus*) model.

Materials and Methods

Because of the differential migration routes of adult and immature Sharp-shinned Hawks, two locations were used for observations. We watched immatures along an isolated section of dunes covered by shrubby vegetation (<2 m height) near Cape May Point, New Jersey (38°40' N, 74°58' W). Adult birds were viewed at Raccoon Ridge, Blairstown, New Jersey (39°40' N, 75°02' W). Adults were rare at Cape May as were immatures at Raccoon Ridge and were not included in the analysis. Observations were made between 27 September and 16 October 1980 during the peak migration.

A life-sized plastic Great Horned Owl model was mounted on a pole 2-3 m high and oriented to face oncoming migration. The model was situated in the center of a 60 m wide arena which was perpendicular to migration and marked by altering prominent vegetation. The location of the arenas at both sites were chosen to maximize both observation and the number of migrants exposed to the model. Hawks passing through the arena at an altitude less than 10 m were considered to be potential candidates for exhibiting anti-predator behavior. Birds flying higher than 10 m rarely responded to the model. Hawks approaching from outside the

arena were also noted. To minimize disturbance to the approaching hawks the observer quietly sat approximately 10 m behind and to one side of the model facing oncoming migration. Notes were taken only after a behavioral bout was complete. Sharp-shinned Hawks did not seem to be disturbed by observer presence, and many approached the model while it was being positioned by the observer. These latter responses were not included in the data set.

Results and Discussion

For convenience of description and analysis, anti-predator responses were conceptualized as having 4 sequential phases: recognition, reorientation, approach and resumption of migration. Because it was impossible to determine whether or not hawks actually recognized the model as an owl, we operationally defined recognition as having occurred if the model was attacked and recognition distance as the point at which a reorientation by the migrant was observed. Nearly 70% (90 of 131) of the hawks passing through the arena approached the owl (Table 1). Recognition occurred at distances well beyond the borders of the arena as 30.1% (28 of 70) of immatures responded to the model from outside the arena (distances greater than 30 m).

Table 1. Anti-predator behavior of Sharp-shinned Hawks to a model Great Horned Owl. The percentages for birds vocalizing, making tarsal threats and multiple approaches are given as proportions of those birds eliciting these behaviors out of the total number that approached the model.

	Sample Sizes	Aggressive Approaches	Approach Distance (m) \pm SD	Vocalizing	Tarsal Threats	Multiple Approaches
Adults	28	71.4% (20)	.78 \pm .39	10.0% (2)	10.0% (2)	0.0% (0)
Immatures	103	68.0% (70)	1.42 \pm .62	17.1% (12)	18.6% (13)	20.0% (14)
Total	131	68.7% (90)	1.24 \pm .55	15.6% (14)	16.7% (15)	15.6% (14)

The hawks reoriented in several ways. Where the direction of approach was noted 29 of 37 (76.3%) hawks continued past the model to the border or beyond the arena only to approach from the side or back of the model. Although these birds were confronted with the owl's front (face and eyes) they approached from another side even though it took them out of their migratory pathway. To determine whether or not hawks were preferentially avoiding the front of the model (side with eyes) or were approaching along a line of vegetation used as cover for the approach, the model was rotated 90° away from the direction of oncoming migration. Seventeen of 23 (75.1%) hawks approached from the sides or back. There were no significant differences ($X^2 = .12$, $df = 1$) between these distributions and the results can be attributed to an avoidance of the model's face.

Approaches were characterized by low glides 1–3 m above the surrounding vegetation. No wing movement occurred during the last 10–15 m and approaches were ordinarily to within 2 m of the model. The birds' tarsi were sometimes lowered during the final 5 m. This behavior may have an aerodynamic function, be an aggressive threat, or an aborted act of physical aggression. It was obvious that in some cases the legs were used as airbrakes while in others they were aggressively thrust down at the owl model.

The end of the approach was marked by an abrupt turn away from the owl model and commencement of flapping flight in the original direction. As the hawk flew away a quiet "kiif" or "seet" vocalization (Bent 1937) was sometimes audible. In some cases the hawk proceeded a few meters, turned and made a second or even third pass at the

owl. In 4 cases Sharp-shinned Hawks perched in trees 20 m away before or after the approach and appeared to stare at the owl. One of these individuals gave the "kek kek kek kek . . ." vocalization reported by Bent (1937).

In Table 2 a comparison is made of the anti-predator responses of passerines and Sharp-shinned Hawks. The overall anti-predator responses of these hawks are somewhat different from those of passerines but are consistent with Hartley's (1950) definition of mobbing. The responses by this raptor, which seldom last more than a few seconds, are of shorter duration than those of passerines, which can persist over several minutes. The attacks by Sharp-shinned Hawks are more aggressive and potentially more damaging than those of most passerines. The greatest differences are between the stealthy and solitary nature of the hawk attacks and loud demonstrations by groups of passerines. Thus, mobbing of owl models by Sharp-shinned Hawks is performed within the same context and range of responses as mobbing by passerines, although the actual behaviors are dissimilar.

Table 2. Comparison of attack behavior of Sharp-shinned Hawks and mobbing behavior of passerines. Compiled from previously cited literature for passerines including Curio (1978), Harvey & Greenwood (1978) and Tinbergen (1953).

Characteristics of Behavior	Sharp-shinned Hawks	Passerines
Mobbing by groups	Infrequent	Often—Always
Vocalizations	Infrequent (soft)	Frequent—Always (loud)
Perching near predator	Infrequent—Rare	Frequent
Use of tarsi	Uncommon—Threats potentially damaging to predator	Tarsi not often used. Pecking with bill infrequent
Approaches	Single approach most often No flapping	Multiple approaches (approach-withdraw), Flapping and wing flipping
Duration	Short (seconds)	Usually long (minutes)

The significance of Sharp-shinned Hawks attacking the models is not readily evident as no accounts of predation on this species by owls were found in the literature. Studies by Mikkola (1976) and Newton (1979) report heavy predation from some localities upon the slightly larger European Sparrowhawk (*A. nisus*) by Eagle Owls (*B. bubo*) and Tawny Owls (*Strix aluco*). The frequent and aggressive responses of Sharp-shinned Hawks to a model owl suggests that predation on this species is probably more prevalent than reported in the literature.

We thank P. Dunne of the Cape May Bird Observatory for suggesting the study sites. S. Kerlinger made suggestions on experimental design. We also thank an anonymous reviewer for helpful comments of an earlier draft of this paper.

Literature Cited

- Bent, A. C. 1937. Life histories of North American birds of prey. Dover, New York.
- Curio, E. 1975. The functional organization of anti-predator behavior in the Pied-flycatcher. A study of avian visual perception. *Anim. Behav.* 23:1-115.
- . 1978. Cultural transmission of enemy recognition: One function of mobbing. *Science* 202: 899-901.

- Hartley, P. H. T. 1950. An experimental analysis of interspecific recognition. *Symp. Soc. Exper. Biol.* 4:313-336.
- Harvey, P. A. and P. J. Greenwood. 1978. Anti-predator defence strategies: Some evolutionary problems. In J. R. Krebs and N. B. Davies, eds. *Behavioral Ecology: An evolutionary approach*. Sinaur Associates, Sunderland, Mass. pp. 129-154.
- Hinde, R. A. 1954. Factors governing the changes in strength of a partially inborn response, as shown by the mobbing behavior of the Chaffinch (*Fringilla coelebs*). I. The nature of the response, and an examination of its course. *Proc. Roy. Soc. of London Series B, Biological Sciences* 142:306-331.
- Mikkola, H. 1976. Owls killing and killed by other owls and raptors in Europe. *British Birds* 69:144-154.
- Newton, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, S.D.
- Nice, M. M. and J. ter Pelkwyk. 1941. Enemy recognition by the song sparrow. *Auk* 58:195-214.
- Smith, M. J. and H. B. Graves. 1978. Some factors influencing mobbing behavior in Barn Swallows (*Hirundo rustica*). *Behav. Biol.* 23:355-372.
- Tinbergen, N. 1953. Social behavior in animals. Methuen & Co., London.

COMPOSITION AND SEASONAL VARIATION OF THE BARN OWL (*TYTO ALBA*) DIET IN ARIZONA

by

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Abstract

We analyzed Barn Owl (*Tyto alba*) castings collected during August 1974 to May 1977 from birds inhabiting an urbanized Sonoran desert community. Prey species composition and age (adult versus juvenile) varied seasonally. The cotton rat (*Sigmodon arizonae*) was the most frequent prey, comprising 38.8% of the overall diet.

Introduction

Numerous studies have detailed owl diets through analysis of pellets (Maser and Brodie 1966, Maser and Hammer 1972, Marti 1969, 1974, Ohmart and Anderson 1976, and others). These studies have indicated the reasons for the usefulness of pellets in food studies. Although diet composition has been determined for various owl species, little in-

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formation is available for owls in more xeric environments. This paper considers seasonal variation in the diet of the Barn Owl (*Tyto alba*) inhabiting an urbanized Sonoran desert community.

Materials and Methods

Barn Owl castings were collected below an approximately 20 m tall cottonwood (*Populus fremontii*) in Tempe, Arizona (Maricopa County), from August 1974 to May 1977. The owls vacated the study site each May and returned in late August; thus information on prey taken during the summer was not available. The isolated tree was in a disturbed, sparsely vegetated field within 2 m of a canal, and approximately 20 m south of agricultural fields (primarily alfalfa). Homes and apartment buildings were situated along the east side of the field within 30 m of the roost tree. This apparently was a feeding roost, since neither adult owl was observed in this tree during daylight hours but both frequently used it at night.

Pellets ($n=77$) were prepared and analyzed using standardized methods (Korschgen 1980). Identification of mammals was based on skulls including mandibles, with particular emphasis on dentition. Birds were identified by the size and shape of the skull and, when possible, by comparison of the specimen to a skull of known origin.

Results

Eight species, 4 mammals, 3 birds, and 1 crustacean constituted the prey of Barn Owls (Table 1). Cotton rats (*Sigmodon arizonae*) were the most common component in the overall diet (38.8%). Barn Owls consumed substantially more juveniles than adults. Cotton rats were a major dietary element during the spring (30.0%), when slightly more valley pocket gophers (*Thomomys bottae*) (36.7%) were taken. In contrast to cotton rat prey, Barn Owls ingested considerably more adult than juvenile pocket gophers.

Table 1. Seasonal Barn Owl (*Tyto alba*) pellet analysis.

	Adult		Juv.		Fall		Total		%		Season ^a Winter		Total		%		Spring		Total		%		Year		Total		%	
Cotton rat (<i>Sigmodon arizonae</i>)	2		5		7		53.8		5	12	17	41.5	3	6	9	30.0	33	38.8										
Valley pocket gopher (<i>Thomomys bottae</i>)	1		-		1		7.7		4	1	5	12.2	9	2	11	36.7	17	20.0										
Miscellaneous mammals ^b	1		-		3 ^b		23.1		2	2	12 ^b	29.3	1	-	9 ^b	30.0	25 ^b	29.4										
Birds ^c	2		-		2		15.4		4	-	6 ^d	14.6	1	-	1	3.3	9 ^d	10.6										
Crayfish	-		-		-		-		-	-	1	2.4	-	-	-	-	1	1.2										
TOTAL	6		5		13 ^d		100.0		15	15	41 ^d	100.0	14	8	30 ^d	100.0	85 ^d	100.0										

^aSeasons: Fall = October; Winter = November–March; Spring = April–May

^bIncludes unidentified Cricetid and other rodents, desert cottontail (*Sylvilagus auduboni*), and black-tailed jackrabbit (*Lepus californicus*)

^cIncluded unidentified birds, House Sparrow (*Passer domesticus*), Great-tailed Grackle (*Quiscalus mexicanus*) and Ground Dove (*Columbina passerina*)

^dIncludes remains not identifiable to age

Discussion

Owls are noted for their exquisite adaptations for nocturnal predation (Payne 1962), so it was to be expected that the major portion of their food intake consisted of small mammals that often were nocturnal. The crayfish, undoubtedly, was taken from the

canal adjacent to the roost tree. It is not known if the birds were taken during daylight, nocturnal or crepuscular foraging periods. Marti (1974) noted that Barn Owls in north-eastern Colorado hunted strictly after dark; however, daylight hunting has been observed for this species (Harte 1954, Haverschmidt 1970). Owls using the study area often began foraging before sunset. This suggests the birds could have been taken during crepuscular or daylight as well as nocturnal hours.

The proportion of birds in the diet was lowest during the spring possibly because rodent availability may have been higher at those times. Maser and Hammer (1972) noted 0.3% bird, 0.6% Coleoptera, and the remainder mammals in Oregon Barn Owl pellets from birds roosting near cultivated (primarily alfalfa) fields. Of these mammals, 21.4% were mountain pocket gopher (*Thomomys talpoides*), the only congener of a prey species also found in this study.

Ohmart and Anderson (1976) noted that Barn Owl diets consisted of 55.5% mammal and 15.7% bird components in samples collected from a variety of desert ecosystems along the Colorado River. The valley pocket gopher comprised the largest (24.0%) mammal constituent in the diet, in comparison to 20.0% in this study, whereas the cotton rat represented 5.2% (38.8% in this study). Ohmart and Anderson suggested that the primary foraging areas were in and around agricultural and marsh communities because remains of birds, arthropods, amphibians, a reptile, and a variety of plant species were found in the pellets.

More juvenile than adult cotton rats were taken by the owls in this study, whereas the inverse was true for pocket gophers. It has been noted that where cotton rats occur, they tend to be the most numerous mammal, are active day and night, and have an enormous reproductive potential (Hall and Kelson 1959). Cotton rats and pocket gophers have relatively short gestation periods (27 days for cotton rats, 18–19 days for pocket gophers), similar litter sizes (average 5–6, a maximum of 12), produce several litters per year, and do not hibernate (Hall and Kelson 1959). Hence, young and adults are available as prey throughout the year. Because cotton rats are active on the surface, whereas pocket gophers restrict their activity to tunnels with an occasional visit to the surface to disperse excess earth (Ingles 1947), young cotton rats are probably more susceptible to predation by owls than are young pocket gophers.

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Literature Cited

- Hall, E. R., and K. R. Kelson. 1959. *The Mammals of North America*. Ronald Press, New York.
- Harte, K. 1954. Barn owl hunting by daylight. *Wilson Bull.* 66:270.
- Haverschmidt, F. 1970. Barn owls hunting by daylight in Surinam. *Wilson Bull.* 82:101.
- Ingles, L. G. 1947. *Mammals of the Pacific States*. Stanford Univ. Press, Stanford, CA.
- Korschgen, L. J. 1980. Procedures for food-habits analyses. In S. D. Schemnitz (ed.), *Wildlife Management Techniques Manual*, 4th ed. Wildlife Society, Wash., D.C.
- Maser, C., and E. D. Brodie. 1966. A study of Barn owl pellet contents from Linn, Benton, and Polk Counties, Oregon. *Murrelet* 47:9–14.

- Maser, C., and E. W. Hammer. 1972. A note on the food habits of Barn owls in Klamath County, Oregon. *Murrelet* 53:28.
- Marti, C. D. 1969. Some comparisons of the feeding ecology of four owls in north-central Colorado. *Southwest. Natur.* 14:163-170.
- Marti, C. D. 1974. Feeding ecology of four sympatric owls. *Condor* 76:45-61.
- Ohmart, R. D., and B. W. Anderson. 1976. Barn owls food habits on the lower Colorado River. In B. W. Anderson and R. D. Ohmart. A vegetation management study for the enhancement of wildlife along the lower Colorado River. Ann. Rept. to Bur. Reclam. App. C, pp. C1-C9.
- Payne, R. S. 1962. Acoustical location of prey by the Barn Owl (*Tyto alba*). Ph.D. thesis, Cornell Univ., Ithaca, New York. 113 pp.

LOCAL AND MIGRATORY MOVEMENTS OF RADIO-TAGGED JUVENILE HARRIERS

by

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Abstract

To determine post-fledging movements of the juvenile Northern Harrier (*Circus cyaneus*) hatched on the Buena Vista Marsh, central Wisconsin, I radio-tagged both adult and nestling harriers. I followed the local movements of 7 radio-tagged juveniles from 3 nests, 1 nest in 1976 and 2 in 1977, and the early migratory movements of 3 of these juveniles in 1977. All 7 remained within 1.4 km of their nests for about 3 weeks after their first flights. They did little if any hunting during this period. Five of the 7 left the study area between 20 and 23 days after fledging. One juvenile was killed near its nest by a predator 32 days after fledging, and the last one left the study area 50-51 days after fledging.

I obtained information on 4 of the 6 juveniles that left the study area. All 4 left alone, rather than with parents or siblings. Three were located during migration. Their migratory movements were interrupted by the establishment of temporary home ranges that were used for 2-3 weeks. One juvenile was located once 71 km southeast of her nest. Another was monitored in two temporary home ranges, one 85 km east-southeast and another 171 km southeast of his nest. A third juvenile was tracked continuously until she was in a temporary home range 164 km southeast of her nest. All known locations of the migrating juveniles were in the southeast quarter of Wisconsin. Case histories of the movements of these 3 juveniles are presented in detail.

Introduction

Several long-term investigations have been conducted on *C. cyaneus* (Balfour 1957, 1962, 1963, 1968; Balfour and Cadbury 1975; Watson 1977; and Hamerstrom 1969, 1979). Very little, however, is known about the post-fledging period of the harrier breeding cycle. Fisher (1893), without giving any evidence, stated that "After the young are reared and leave the nest they remain together, and as fall advances several families

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unite and migrate southward." Beebe (1974) stated that fledged young harriers associate with their parents for about 3 weeks; Breckenridge (1935) thought that the family group broke up when the young were about 8 weeks of age. Previous dispersal data (Hammond and Henry 1949, Watson 1977) have been based only on banding returns and suggest that a combination of migration and random dispersal occurs after the nesting season.

These fragmentary statements clearly show a need for a study of post-fledging movements of juveniles. My purpose was to determine movements of juvenile harriers around their nests and pattern of dispersal from the study area. Because this is the first study of dispersing juvenile harriers, their case histories are described in detail.

The juveniles were hatched on the Buena Vista Marsh, Portage County, Wisconsin during 1976 and 1977. The study area has been described by Hamerstrom et al. (1957). The juveniles were found and tracked in the southeast quarter of Wisconsin after leaving the Buena Vista Marsh.

Methods

The juvenile harriers were radio-tagged with crossed-loop backpacks, described by Beske (1978), at 30–35 days of age, just before they were capable of sustained flight. Life expectancies of the radio-packages ranged from 333–400 days.

The juveniles were also individually color-marked by bleaching 4 adjacent primaries, secondaries, or rectrices as described by Ellis and Ellis (1975).

I used a 1972 Volkswagen bus outfitted with a Hy-Gain Model 28 antenna (Hy-Gain Electronics Corp., Lincoln, Nebraska) that could be rotated from inside the vehicle and an LA 12 receiver (AVM Instrument Co., Champaign, Illinois) for ground tracking. When ground contact was lost, I searched for the signal with a Cessna 150 or similar aircraft, to which Cush Craft A147-4 4-element yagi antennas (Cush Craft, Manchester, New Hampshire) were attached to both wing struts. A switch box connected to the antennas allowed me to search on either side of the aircraft. I flew straight line transects at 19.3 km intervals at altitudes of 762–1067 m above ground level until I received the signal. Then I circled the signal at lower altitudes, 90–150 m, to determine the bird's exact location.

On 24 July 1976 I radio-tagged and color-marked the 2 oldest juveniles, both males, at a nest of four. I also color-marked the other 2 young, a male and female, and the 2 adults. I monitored the radio-tagged birds daily until 13 August and recorded 32 locations for each. Studies in 1976 were limited to local movements.

In 1977 I radio-tagged and color-marked all 3 juveniles at 1 nest. One female (hereafter referred to as F1) was tagged on 21 July and the other two young, a male (M1) and a female (F3), were radio-tagged and color-marked the next day. At another nest 2 juveniles, a male (M2) and a female (F2), were radio-tagged and color-marked on 21 July; a female nestmate was flying too well to be captured. I estimated hatch date of the oldest bird at each nest to be about 18 June, by using an age scale based on measurements of the longest remex, a modification of an age scale by Scharf and Balfour (1971). Harriers do not leave the nest abruptly but move in and out over a period of days; they leave before they are capable of sustained flight. Fledging date is thus difficult to define. The date of radio-tagging can be considered as the fledging date for these birds.

I recorded 115 locations of the 5 radio-tagged juveniles through 11 August. These radio locations were supplemented by visual observations whenever the birds were visible. Observation times ranged from 5 to 60 min and were distributed throughout the daylight hours.

Movements around the nest were recorded on acetate overlaid on aerial photographs. After the juveniles dispersed from the study area I followed individual birds for periods of 3–5 days from 13 August to 21 October and recorded their movements on county highway maps.

A compensating polar planimeter was used to measure areas.

Results

Local Movements

The 2 juveniles radio-tagged in 1976 remained near their nest from 24 July until 13 August. On 16 August I could locate neither of the tagged young, their color-marked

siblings, nor either adult. Apparently the whole family left the area on 14 or 15 August. I checked the nest site and surrounding 23.3 km² periodically for the next 3 days but never picked up a signal or saw any of the marked birds again. I do not know if the family group left together. The juveniles had been flying for about 20 days when they left. I made no attempt to locate them off the study area.

The young stayed near the nest until they disappeared. All radio-locations were within 0.6 km of the nest and the radio-tagged young were always found within 180 m of each other.

I saw very little activity during the immediate post-fledging period. From 24 July through 2 August tagged and untagged juveniles made short flights around the nest, but spent most of the time out of sight on the ground. By 3 August they perched on small shrubs although their landing attempts were still quite clumsy.

The oldest radio-tagged juvenile unsuccessfully chased a small passerine for about 28 m on 7 August. This was the only definite hunting behavior I saw before dispersal.

All three juveniles (F1, F3, and M1) at one 1977 nest remained within 1.4 km of their nest from 21 July until 11 August. These 3 birds used an area of 56 ha during the post-fledging period (Fig. 1). M1 left the study area on 11 August, 20 days after fledging, and F1 left the next day. F3 remained near the nest for 50 days after fledging and left on 10 or 11 September.

The two juveniles (F2 and M2) at the other nest remained within 1.0 km of their nest and used an area of 49 ha. F2 left the study area on 13 August, 23 days after fledging. M2 remained near his nest for 32 days after fledging. I found him freshly killed, apparently by a Great Horned Owl (*Bubo virginianus*), in his night roost 0.6 km from his nest on 22 August.

The juveniles at both nests were always located within 180 m of their siblings. Although they often chased and followed each other, I never saw any of them follow their parents on hunting forays. The adults at both nests, all radio-tagged or color-marked, spent very little time within the range of the young during the post-fledging period, visiting it only when bringing prey to them, to defend against intruders, or for very short periods of perching or preening. The young usually became inactive if the adults detected me, but my presence did not seem to affect them when adults were not nearby.

Again in 1977 I saw no prey taken by the juveniles before they left the study area.

Migratory Movements

Dispersal of the radio-tagged young harriers at the onset of migration can best be described as a slow, generally southeasterly movement interrupted by pauses at temporary home ranges. I define a temporary home range as an area used by a bird for a period of several days. I have divided movements into three main types: 1) Permanent moves are one-way flights from a night roost or temporary home range to another without going back. 2) Exploratory flights are flights from a temporary home range and back (two-way flights). 3) Home range movements are flights that were repeated during a period of several days in a limited area.

Of the 5 juveniles radio-tagged in 1977, 1 (M2) was killed before migrating, and 1 (F3) left 50 or 51 days after fledging and was not seen again. Three, M1, F1, and F2, dispersed from the study area 20, 22, and 23 days respectively after fledging. I located all 3 off of the study area; their dispersal is discussed below.

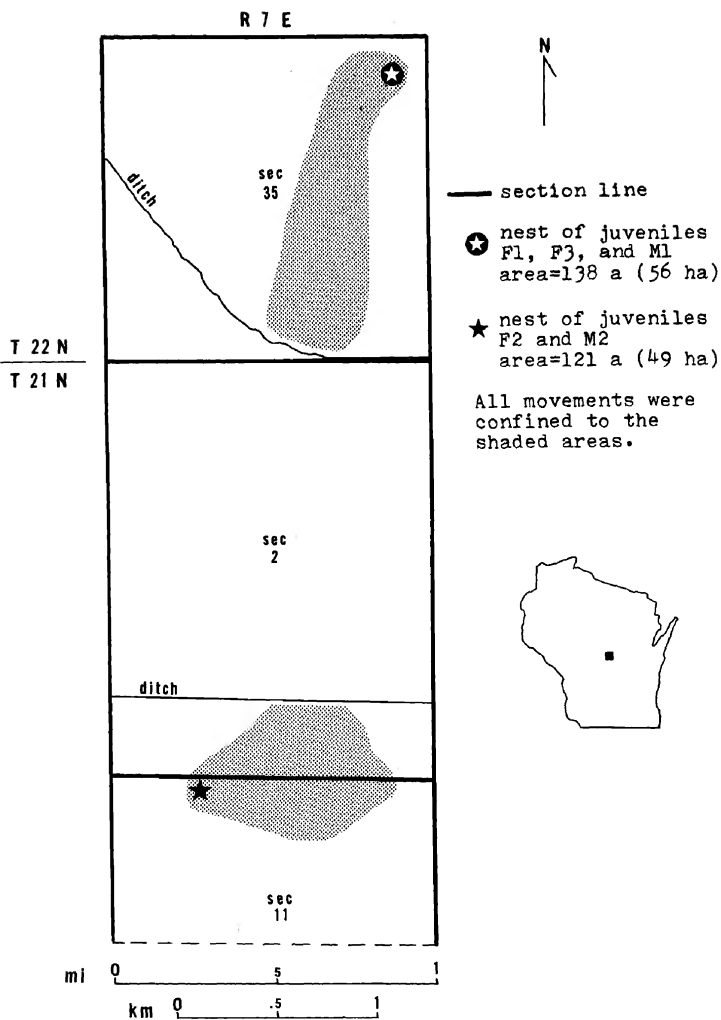


Figure 1.—Local movements of five radio-tagged juvenile harriers around two nests in 1977 on the Buena Vista Marsh, Wisconsin.

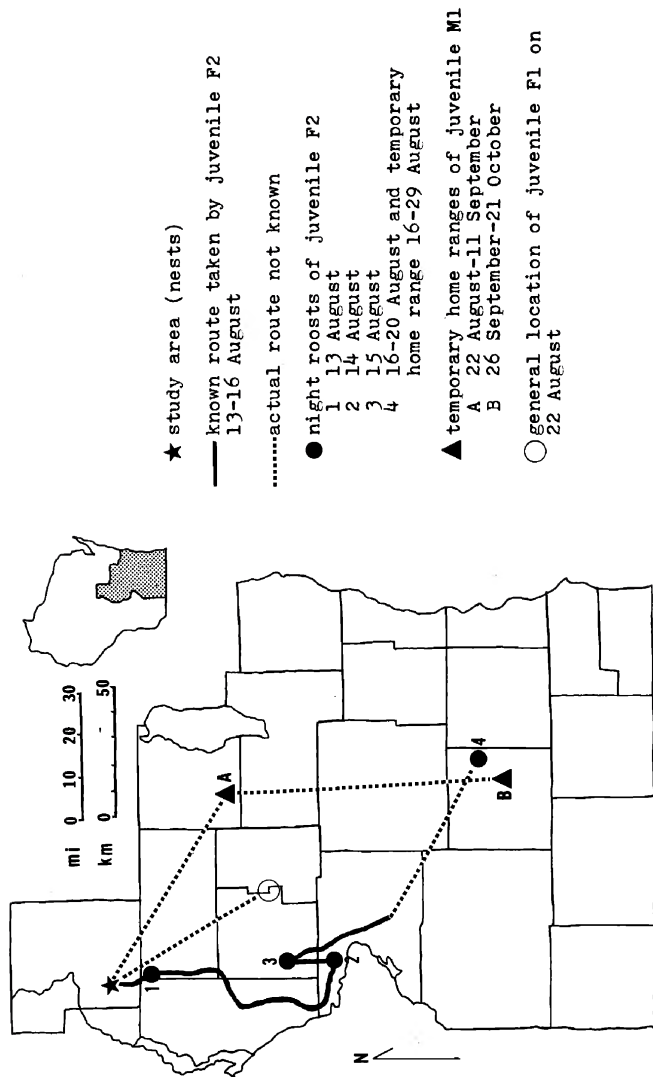


Figure 2.—Overall migratory movements and locations of roosts and temporary home ranges of three juvenile harriers: 11 August-21 October 1977.

Case history of F2: F2 remained within 1.0 km of her nest until 13 August. At 1500 (Central Standard Time) that day she started soaring and began moving south. She soared south about 14.5 km during the next hour and then quit soaring and began wandering through several sections of land during the next 2 hours. By 1800 she had perched in a plantation of 4.3 m high red pines (*Pinus resinosa*) and remained there until dark (roost 1, Fig. 2).

The next morning F2 flew out of this unusual roost (unusual because harriers do not normally frequent dense woods) at 0503, began flying southeasterly, turned south. By 1000 she was 12.9 km south of the roost. A northwest wind had gradually come up and at 1009 F2 began soaring. She rose quickly to an estimated 213–244 m and started moving more quickly to the south. She soared for 9.7 km and then moved southwesterly for 16 km. Then she turned south again for 30.9 km. At 1154 I lost radio signal. I located her again at 1259. She had quit soaring and was hunting. By 1310 she began soaring again, although only rising to about 30 m and continued south. She moved 5.6 km during the next hour and began meandering over several square kilometers during that time. I lost her signal from 1410 to 1450 and when I located her again she was moving east-southeast, paralleling the Wisconsin River. She moved 22.5 km in this direction and again began wandering from 1700 to 1800. Her wandering flight was low and slow and limited to low marshy areas. By 1858 she was confining her movements to a small (about 4 ha) marsh and by 1916 she was inactive. She did not fly during the next 20 min and the signal indicated that she was totally inactive and probably asleep. This roost (roost 2, Fig. 2) was 71 km from the previous night's roost although she travelled much farther during the day.

The next morning, 15 August, F2 was already active by 0434, but was still on the ground where I left her the night before. She did not leave the roost until 0455 and then flew only briefly. There was a moderate ground fog which began lifting about 0600 and at 0612 F2 began hunting. She spent the rest of the morning hunting and perching within 1.6 km of the roost. The wind switched to the south and by 1100 it was blowing 10–19 km/hr. At 1240 I lost the radio signal. She had drifted downwind, and because she moved straight away from me, I had not been able to detect the movement. About 1800 I picked up the signal in another marsh 19.3 km north of where I lost her. By 1923 I located her roosting in the new marsh (roost 3, Fig. 2).

It rained during the night and the next morning was overcast and calm with a slight mist. At 0552 the bird was near her roost and fairly inactive. The weather started to clear and at 0612 she began hunting. She spent the next 3 hrs coursing the marsh. A northwest wind came up and by 0945 it was blowing 16–32 km/hr. F2 began circling up at 0950. She moved slowly to the southeast for about 9.7 km during the next 2 hrs. At 1201 she started soaring with 2 other harriers and all 3 started drifting quickly to the south-southeast. F2 continued to move south-southeast for another 29 km. Her flight was fast and direct. I began to lose her signal at 1405 and after 1415 lost it completely. It was 1800 before I located the signal with an aircraft 68 km southeast of where I lost her in the afternoon. By dark I pinpointed her roosting location 106 km from the previous night's roost (roost 4, Fig. 2).

The next morning, 17 August, F2 began hunting at 0520 and spent the rest of the day hunting, perching, and soaring within 3.2 km of the roost. Even though it was a perfect migration day with strong northwesterly winds, she made no long moves. She was inactive by 1915 and roosted about 137 m south of her roost of the night before.

I followed F2 from dawn until dark for the next 3 days, 18–20 August, and she made no large moves (see Fig. 3). She continued to use the same roost and hunt the same areas. She made 2 short exploratory flights away from the roost site, but returned to her temporary home range within 3 hours. The area of her temporary home range was 6 km². She was now 164 km from her nest. After she roosted on 20 August I returned to the Buena Vista Marsh to check the other radio-tagged young.

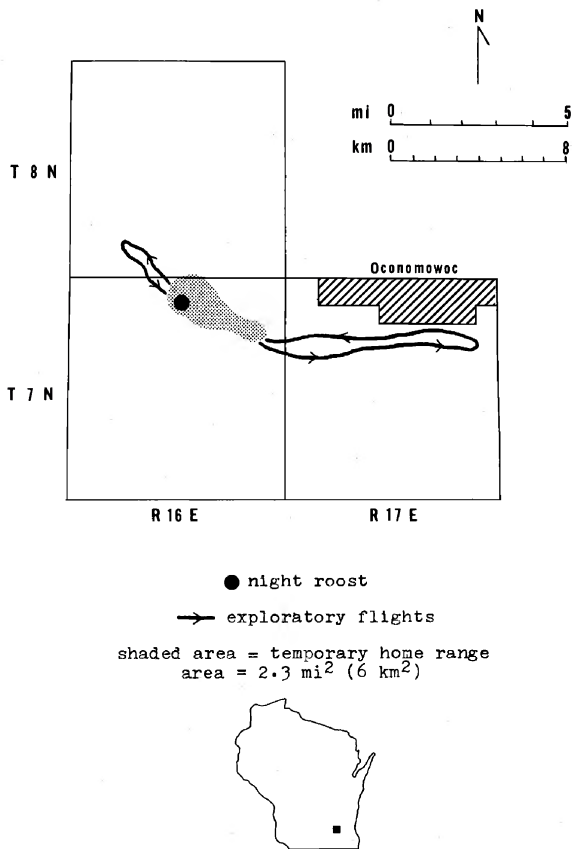


Figure 3.—Temporary home range, roost site, and exploratory flights of juvenile F2, 16–20 August. She was still present on 22 and 29 August 1977.

I flew transects east of the Buena Vista Marsh to Lake Michigan and south of the study area to the Illinois-Wisconsin border on 22 August (Fig. 4). I located F2 where I left her on 20 August. She was in the same place again on 29 August, and had apparently been there for 13 days.

On 9 and 11 September I searched the marsh and the surrounding 15.5 km² area, but could not locate F2. Apparently she left between 30 August and 9 September.

I was unable to fly search transects from 13 to 24 September. On 25 and 26 September I searched the southeast quarter of the state again (Fig. 4), but did not find F2. I never picked up her signal again.

Case history of M1: M1 was the first young to leave the study area. He left sometime after 0830 on 11 August, 2 days before F2. I had no contact with M1 until 22 August, when I found him 85 km east-southeast of his nest (temporary home range A, Fig. 2). I located him nearby from the air at 1500 on 23 August, and again at 0515 on 24 August. I followed him by car until he went to roost that day, and from dawn to dark the next day. He remained within 5.6 km of his roost during those 2 days, except for one afternoon exploratory flight of 27 km south and back (Fig. 5). The area of this temporary home range was 19.4 km².

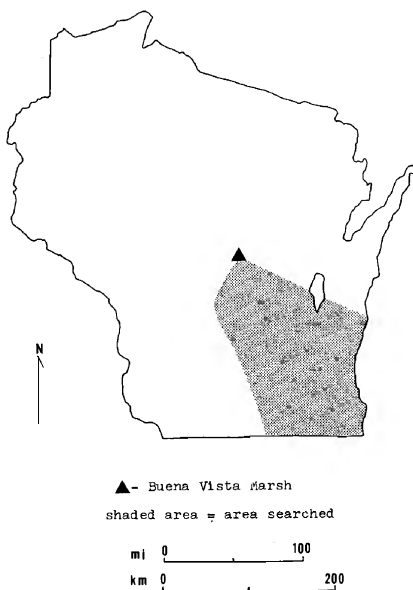


Figure 4.—Area of Wisconsin searched for radio-tagged juvenile harriers on 22 and 29 August, 25 and 26 September 1977 and 17 May 1978.

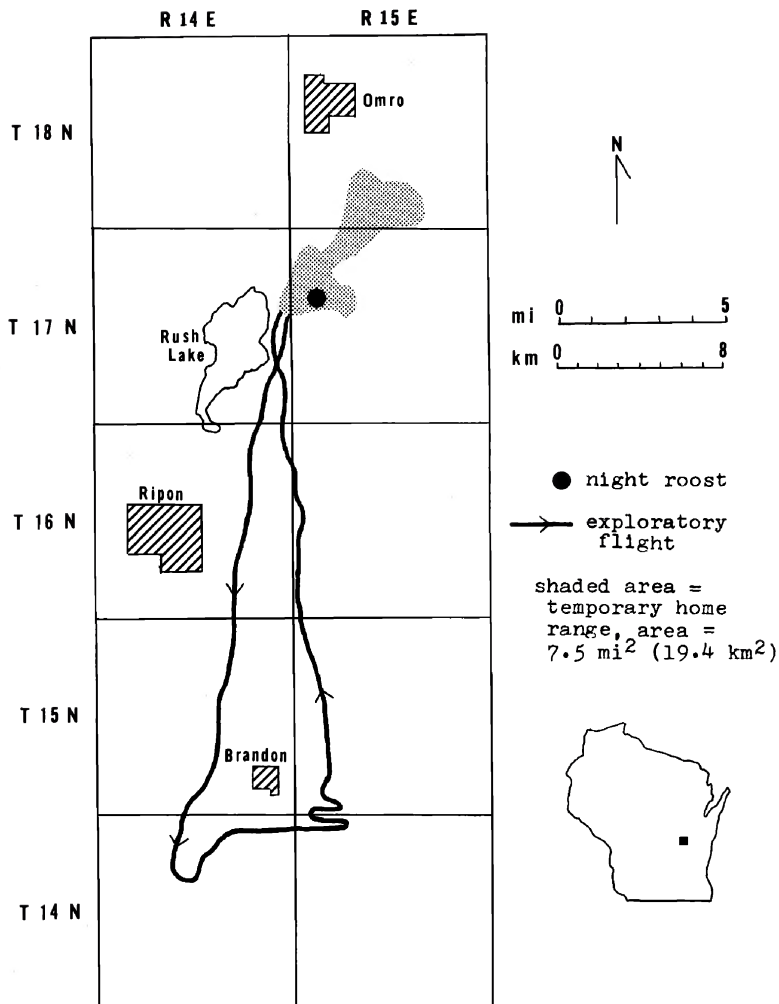


Figure 5.—Temporary home range A, roost site, and exploratory flight of juvenile M1: 22–25, 29–30 August and 9 and 11 September 1977.

M1 was in the same marsh on 29 August and in his usual roost that evening; he remained in that marsh during the next morning. He was near his roost late in the day on both 9 and 11 September, even though 10 September had been an excellent migration day. At this point, he apparently had been using the same marsh for at least 21 days.

On 26 September I found him 109 km to the south-southeast. He was now 171 km southeast of his nest 46 days after leaving the nest area (temporary home range B, Fig. 2). On 28 September I located him just before dark near his location of 26 September. I tracked him in this temporary home range through 30 September and again from 18 through 21 October; he made no permanent moves during this time (Fig. 6). His movements in temporary home range B covered an area of 80 km². I searched this and adjacent areas for M1, from the ground, on 10 November but I was unable to find him.

My last contact with M1 was on 21 October, 64 days after he left the nest area. His dispersal had been interrupted by stopovers at 2 areas. The first 85 km from his nest and was used for at least 21 days; the second, at 171 km, was used for at least 25 days.

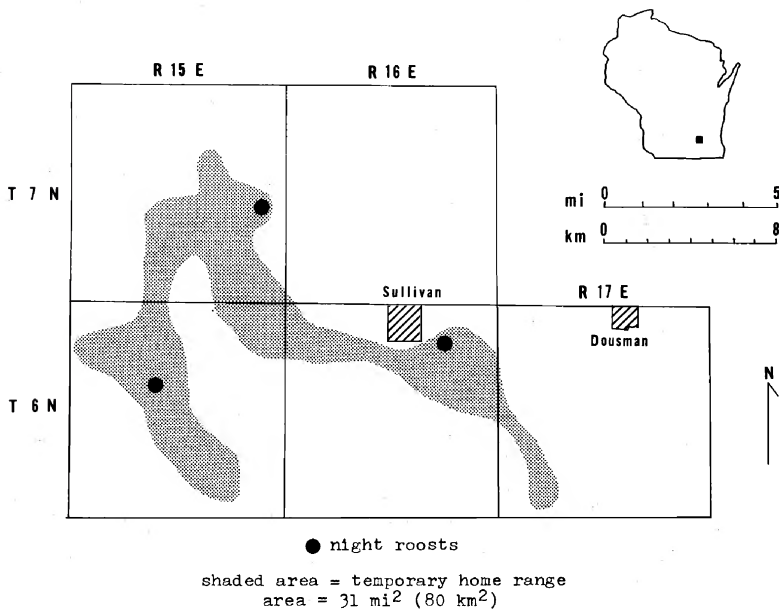


Figure 6.—Temporary home range B and roost sites of juvenile M1: 26, 28–30 September and 18–21 October 1977.

Case history of F1: F1 left the study area on southwesterly winds on 12 August. While I was watching her she suddenly, at 0930, flew east from the area in which she had spent the past 3 weeks. This move should have alerted me that she was leaving. I watched her fly out of sight and did not find her again until I flew transects over the southeast quarter of the state on 22 August (Fig. 4). This location (Fig. 2) was not precise. It is the only location I have for her off the study area, even though I searched the southeast quarter of the state again on 29 August and 25–26 September. F1 was about 71 km southeast of her nest 10 days after leaving the nest area.

On 17 May 1978 I flew transects over the southeast quarter of Wisconsin. This area included all known locations of the juveniles after they left the Buena Vista Marsh. Very few harriers, banded as young, have ever returned to the study area (Hamerstrom 1969). I was curious to see if my radio-tagged birds might have returned to the marshes in which they had spent so much time during autumn stopovers, but failed to find them.

Discussion

Local Movements

All of the juveniles remained close to the nest and to their siblings before dispersing. The first week after fledging I never found them more than 91 m from their nest. As they grew stronger on the wing this distance increased to a maximum of 1.4 km at one nest, but the area used did not change after the 2nd week after fledging. The movements around the nest were not random. Although I detect no difference in habitat between used and unused areas, they consistently favored the same area (Fig. 1). Availability of suitable perches (fenceposts and shrubs) may have influenced their local movements.

One might well assume that most local movements of young is associated with learning to hunt. It is possible that they did some hunting before they dispersed, but I saw no evidence except for the one unsuccessful chase in 1976. I saw all the young pouncing on what appeared to be inanimate objects, but this mock hunting never had the intensity that hunting adults display. The young occasionally appeared to be truly hunting and suddenly dived at something, only to fly up with a clump of grass or some other inedible "quarry". These incidents may have been unsuccessful attempts at catching prey, but I suspect they were merely play.

I saw no evidence that adults taught the young to hunt, even by example. Most hunting by adults was not in sight of the young.

Although it seems unlikely that the young would leave their natal area and food supply (their parents) before hunting successfully, this definitely appeared to be the case. K. L. Bildstein (pers. comm.) observed the same lack of hunting by over 20 juveniles at 8 nests he studied in 1977 and 1979.

The adults were still present at both nests in 1977 when the first 3 young dispersed and at least 3 of the adults remained on the study area until after all the young were gone. I saw no suggestion of adults driving away young.

Migratory Movements

Permanent moves: The only permanent moves I actually followed were those of F2 from 13 August to 16 August. These moves were characterized by alternating periods of high soaring or gliding and lower level flapping. Gliding tended to be fast and direct

with little circling or doubling back. From a vehicle confined to roads, it was difficult to estimate ground speed of a harrier soaring and gliding cross country with a tail wind. I estimated the ground speed to average 64 km/hr while gliding fast. Lower level flapping flight speed, 9–30 m above the ground, was easier to estimate because F2 often paralleled a road; it averaged 40–48 km/hr. Occasionally F2 dropped even lower, to within 1 m of the ground, to perch or hunt briefly before regaining height and continuing on. These lulls in travel lasted from 15 to 60 min and included wandering that departed from the main direction of flight. All permanent moves were primarily downwind but deviated slightly to follow drainages and marshes. F2 moved mostly alone although on one afternoon she joined two other unmarked immature harriers and all 3 soared and glided together for the next 19 km until I lost sight of them 1.5 h later. On several other occasions F2 encountered harriers or other raptors and moved with them for periods of 5–15 min.

Permanent moves started after 0830 (except on 14 August when F2 began moving at 0503) and ended 1–2 hrs before sunset. Mueller and Berger (1973) observed 78% of the harriers passing Cedar Grove, Wisconsin between 0800 and 1400. I have no evidence that the birds ever moved at night. Every time I located a radio-tagged harrier in a night roost (N=9) it was still in the same location the following morning.

Exploratory flights: I followed F2 on 2 exploratory flights from temporary home range 4 (Fig. 3) and M1 on 1 exploratory flight from temporary home range A (Fig. 5). Like the permanent moves, exploratory flights took place after 0830 and ended at least 1 hr before sunset. They were initiated after the bird had fed within the temporary home range and were preceded by 1 or more stationary soaring flights as if they were testing the winds aloft. Both birds characteristically moved downwind from their temporary home ranges and returned into the wind. Exploratory flights seemed to end when the bird reached unsuitable habitat. In one case F2 turned back when she reached the edge of a large residential area. In 2 other cases, 1 each with F2 and M1, they turned back when reaching intensively farmed areas. These explorations tended to be fairly direct and slow with little soaring. On returning, the birds always retraced or paralleled their outgoing route as though following visual cues. Persistent hunting was not characteristic during exploratory flights and I saw no prey taken, even though they tended to follow suitable hunting habitat. The radio-tagged birds moved alone during these flights.

Movements within temporary home ranges: When F2 reached roost 4 (Fig. 2) on 16 August I expected her to continue migrating the next day. Instead, except for exploratory flights, she spent the next 4 days in the same area (Fig. 3) even though the weather was good for migration on 2 of those days. She covered the entire temporary home range many times during a day.

M1's temporary home ranges are illustrated in Figures 5 and 6. His daily movements and temporary home ranges were much larger than those of F2. This may have been a sexual difference, individual variation, or difference in quality of habitat.

Night roosts: Before the radio-tagged young left the study area they roosted within 0.8 km of their nests and often roosted within 18 m of siblings. The same roost area was used almost exclusively at each nest. This habit of roosting repeatedly in the same area was resumed on temporary home ranges. F2 used roost 4 for 5 consecutive nights. A1-

though I could not determine if the exact spot was used, all roosts were within a 137 m diameter circle. M1 also used the same roost for at least 5 nights in temporary home range A. By the time M1 reached temporary home range B, however, his pattern changed. He tended to pick widely separated (9.7 km apart) night roosts. Although communal winter roosts of harriers are not uncommon (Bildstein 1979, Brown and Amadon 1968, Weller et al. 1955), I never found radio-tagged young roosting communally: too early in the season, perhaps? In fact, when other harriers were nearby in late afternoon they all moved off separately in different directions as sunset approached.

Hunting behavior during migration: The area around roosts was consistently good for hunting. F2 regularly hunted near her roosts, not only near the 1-night roosts during her permanent moves, but also for 4 days near roost 4 in her temporary home range. Although F2 hunted throughout her home range, the most intensive, successful hunting was concentrated near the roost. M1 also did most successful hunting near his roost in temporary home range A, but by the time he reached temporary home range B this relationship broke down and he flew as far as 13 km from his roost before hunting.

Surprisingly, the young seemed to be easily able to find enough to eat, although I had not seen any of the young take prey before they left the nest area. Both F2 and M1 spent several hours each day loafing, preening and playing. Although it is often difficult to distinguish how seriously a bird is hunting, when they did seem intent on hunting they killed within 15–60 min. Most prey that I saw taken were small mammals, probably *Microtus* spp. F2 also pursued a Common Snipe (*Capella gallinago*) unsuccessfully and struck a female Ring-necked Pheasant (*Phasianus colchicus*) without killing it. M2 killed an adult male Red-winged Blackbird (*Agelaius phoeniceus*) and occasionally chased other small passerines, but his other 12 identified kills were small mammals. Although I observed occasional intensive hunting at all times of day, hunting consistently occurred about 1 hr after sunrise and again 1 or 2 hrs before sunset.

Direction of movements: The radio-tagged young moved southeasterly as did 9 of 12 banded harriers hatched on the Buena Vista Marsh and recovered in their first fall and winter (Fig. 7, F. Hamerstrom, pers. comm.).

The dates of Hamerstrom's band recoveries suggest the movement is slow, similar to the movements of my radio-tagged birds. Evidence that harrier migration continues throughout the entire autumn is given by Mueller and Berger (1961).

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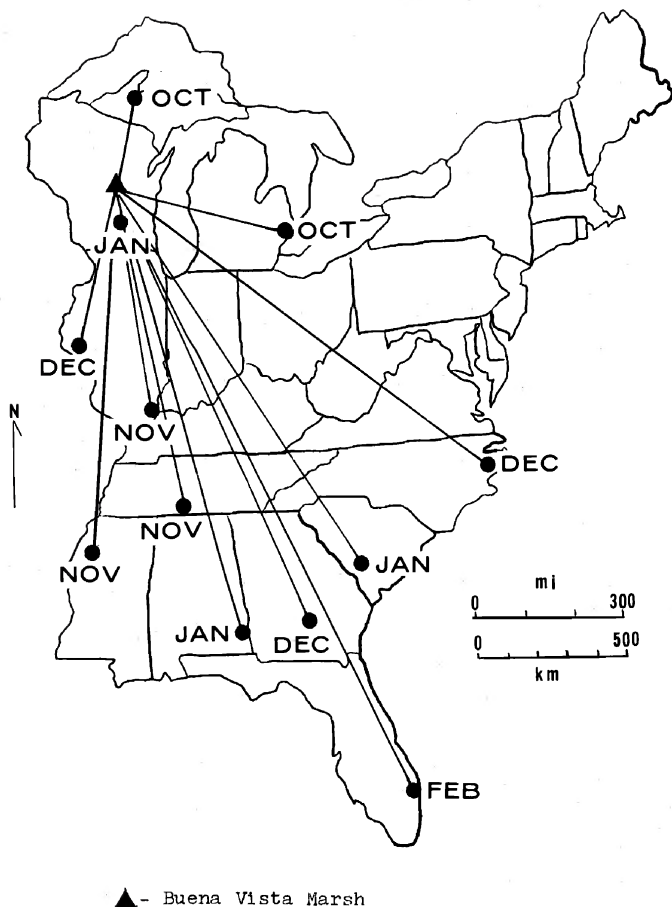


Figure 7.—Banding recoveries of nestling harriers from Buena Vista Marsh during their first fall and winter of life, 1959–1977.

Literature Cited

- Balfour, E. 1957. Observations on the breeding biology of the Hen harrier in Orkney. *Bird Notes* 27:177–183, 216–224.
- Balfour, E. 1962. The nests and eggs of the Hen harrier in Orkney. *Bird Notes* 30:69–73.

- Balfour, E. 1963. The Hen harrier in Orkney. Part 3. Courtship, display, and social-ability. *Bird Notes* 30:145-153.
- Balfour, E. 1968. Breeding birds of Orkney. *Scottish Birds* 5:89-104.
- Balfour, E., and C. J. Cadbury. 1975. A population study of the Hen Harrier (*Circus cyaneus*) in Orkney. Pp 122-128 in R. Goodier, (ed). The natural environment of Orkney. Nature Conservancy Council.
- Beebe, F. L. 1974. Field study of the Falconiformes in British Columbia. Occas. Papers British Columbia Prov. Mus. 17. 163 pp.
- Beske, A. E. 1978. Harrier radio-tagging techniques and local and migratory movements of radio-tagged juvenile harriers. M.S. Thesis. Univ. of Wisconsin, Stevens Point. 47 pp.
- Bildstein, K. L. 1979. Fluctuations in the number of Northern Harriers (*Circus cyaneus hudsonius*) at communal roosts in south central Ohio. *Raptor Res.* 13:40-46.
- Breckenridge, W. J. 1935. An ecological study of some Minnesota Marsh hawks. *Condor* 37:268-276.
- Brown, L. H., and D. Amadon. 1968. Eagles, hawks, and falcons of the world. McGraw Hill, New York. 945 pp.
- Ellis, D. H., and C. H. Ellis. 1975. Color marking Golden eagles with human hair dyes. *J. Wildl. Manage.* 39:445-447.
- Fisher, A. K. 1893. The hawks and owls of the United States in their relation to agriculture. U.S. Dept. Agric., Div. Ornith. and Mammal. Bull. 3. 210 pp.
- Hamerstrom, F. N., Jr., O. E. Mattson, and Frances Hamerstrom. 1957. A guide to Prairie chicken management. Wisconsin Conserv. Dept. Tech. Wildl. Bull. 15. 128 pp.
- Hamerstrom, Frances. 1969. A Harrier population study. Pp 367-383 in J. J. Hickey, ed. Peregrine Falcon populations; their biology and decline. Univ. Wisconsin Press, Madison, Milwaukee and London.
- Hamerstrom, Frances. 1979. Effect of prey on predator: voles and harriers. *Auk* 96:370-374.
- Hammond, M. C., and C. J. Henry. 1949. Success of Marsh hawk nests in North Dakota. *Auk* 66:271-274.
- Mueller, H. C., and D. D. Berger. 1961. Weather and fall migration of hawks at Cedar Grove, Wisconsin. *Wilson Bull.* 73:171-192.
- Mueller, H. C., and D. D. Berger. 1973. The daily rhythm of hawk migration at Cedar Grove, Wisconsin. *Auk* 90:591-596.
- Scharf, W. C., and E. Balfour. 1971. Growth and development of nestling Hen harriers. *Ibis* 113:323-329.
- Watson, D. 1977. The Hen Harrier. T. and A. D. Poyser, Berkhamsted, England. 307 pp.
- Weller, M. W., J. C. Adams, and B. J. Rose. 1955. Winter roosts of Marsh hawks and Short-eared owls in central Missouri. *Wilson Bull.* 67:189-193.

NESTING HABITAT AND NEST SITE CHARACTERISTICS OF THE WHITE-BELLIED SEA-EAGLE IN THE GIPPSLAND LAKES REGION OF VICTORIA, AUSTRALIA

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Abstract

Thirteen nesting territories and 16 nesting trees used by the White-bellied Sea-Eagle (*Haliaeetus leucogaster*) in the Gippsland Lakes region of Victoria, Australia, are described. Concern is expressed about previous losses of nesting habitat and the insecurity of over half of the nesting territories presently active in the area.

Introduction

The White-bellied Sea-Eagle (*Haliaeetus leucogaster*) is well-known around the coastal lakes in the Gippsland Lakes region (Fig. 1), but its biology in the region has never

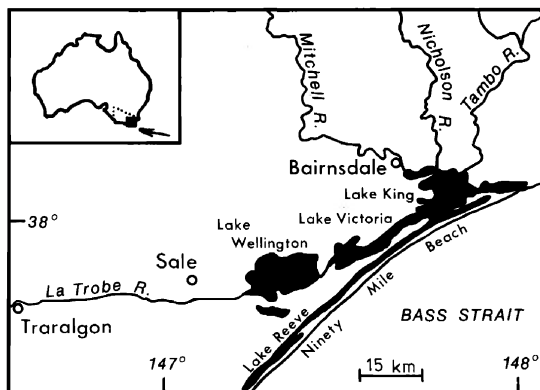


Figure 1. Gippsland Lakes region of Victoria, Australia.

been studied. The only substantial work conducted on the species in Victoria has been along the Murray River (Favaloro 1944); little work has been done elsewhere in Australia.

During 1978 and 1979 we made a concerted effort to find the nesting territories of sea-eagles in the Gippsland Lakes region (excluding Lake Tyers) by searching for nests on the ground and from aircraft, and by obtaining information from local inhabitants. Aerial surveys of known nests were conducted twice during both 1979 and 1980. Here we describe the vegetation in the territories and some characteristics of nesting sites.

Results

Thirteen active (eggs or young or both were present during one or more breeding seasons) nesting territories were found in the Gippsland Lakes region during the 1978–1980 breeding seasons (Table 1). Nine of the 13 territories were within 1 km of one of the coastal lakes in the Gippsland Lakes region. The other four territories were between 2 km and 13 km from the nearest coastal lake, but all were within 1 km of either a large swamp or a river. Seven territories were on private land, another five on public land and one was partially on private and public land.

Table 1. Breeding activity in sea-eagle territories during 1978–1980

Territory	Active* during:			Number of different trees used for nesting during the 3 seasons
	1978	1979	1980	
1	Yes	Yes	Yes	2
2	Yes	Yes	Yes	1
3	Yes	No	No	1
4	Yes	Yes	No	1
5	Yes	Yes	?	1
6	Yes	?	No	1
7	Yes	Yes	Yes	2
8	Yes	No	No	1
9	Yes	Yes	No	1
10	?	Yes	Yes	1
11	?	Yes	No	1
12	?	Yes	No	1
13	?	Yes	Yes	2

*Eggs or young or both observed

The 13 territories were located in 5 vegetation formations comprising eight vegetation units each dominated by 1 or 2 different species of trees (Table 2). In 3 of the nesting territories 2 different trees were used for nesting during the 3 seasons (Table 1). Thus from the 13 territories we have data on 16 different active nest sites (Table 3). The average height of trees supporting nests was 27.8 m and the average diameter at breast height was 1.1 m. Nests were at an average height of 18.9 m. All trees except two *E. tereticornis* were alive, although one *E. botryoides* had been recently burnt and epicormic growth was occurring.

One nest measured *in situ* was 2.4 m deep and 1.2 m × 2.1 m wide; the nesting cup was 0.3 m deep, 0.6 m × 0.8 m wide and lined with fresh eucalypt leaves.

Table 2. Vegetation units where active sea-eagle nests were found at least once in 1978, 1979 and 1980.

Formation	Height of dominants (m)	Characteristic features	Number of sea-eagle nests known to be active in each vegetation unit
Dominant species			
Tall open-forest <i>Eucalyptus pseudoglobulus</i>	30-40	In sheltered gullies and slopes. Dense layer of <i>Pittosporum undulatum</i> to 12 m. <i>E. cypellocarpa</i> common at one site.	2
<i>E. camaldulensis</i>	30-40	On margin of large river. Shrub layer of <i>Acacia dealbata</i> to 12 m.	1
Open-forest <i>E. globoidea</i>	25-30	Dense layer of <i>Pteridium esculentum</i> to 1.5 m. Scattered <i>E. cypellocarpa</i> to 45 m.	
<i>E. bosistoana</i>	20-25	Scattered <i>E. globoidea</i> , <i>E. pseudoglobulus</i> and <i>E. ovata</i> . A few <i>E. bosistoana</i> to 45 m.	1
Open-forest to woodland <i>E. bosistoana</i> and <i>E. melliodora</i>	20-30	Dense layer of <i>Leptospermum phyllocoides</i> to 3 m. <i>E. viminalis</i> on adjacent sandy areas.	1
<i>E. botryoides</i> and <i>Banksia integrifolia</i>	10-25	Usually with a dense layer of <i>Pteridium esculentum</i> to 1 m. <i>Banksia serrata</i> and <i>Leptospermum laevis</i> also present.	3
Closed-scrub <i>Melaleuca ericifolia</i>	3-7	In waterlogged and low-lying areas. Scattered <i>E. tereticornis</i> . <i>Leptospermum juniperinum</i> was co-dominant at one site.	2
Pasture Introduced grasses and crops	<0.5	Scattered <i>E. tereticornis</i> .	2

Discussion

The total number of White-bellied Sea-Eagles nesting in the Gippsland Lakes region is unknown, but we are sure more nesting territories will be found as our study progresses. The present distribution of nesting pairs suggests that the removal of forests from many of the areas along the northern shores of Lakes King, Victoria and Wellington has resulted either in the loss of sea-eagle nests or in some pairs attempting to nest in sub-optimal habitats. Seven species of trees were used to support nests, but one of the 2 most commonly used, *E. tereticornis*, has been extensively cleared from the Gippsland

Table 3. Characteristics of active nest sites of the White-bellied Sea-Eagle.

Species of tree	Number of active nests found during the study	Mean height of tree (m)	Mean height of nest (m)	Mean diameter (m) of tree at breast height
<i>Eucalyptus tereticornis</i>	4	22	15	1.0
<i>E. botryoides</i>	4	23	18	0.8
<i>E. bosistoana</i>	2	34	25	1.2
<i>E. cypellocarpa</i>	2	40	23	1.2
<i>E. camaldulensis</i>	2	32	20	1.7
<i>E. pseudoglobulus</i>	1	27	23	1.4
<i>E. melliodora</i>	1	25	12	0.9
Totals	16	27.8	18.9	1.1
Standard error		2.1	1.4	0.1

Lakes region (Fell 1972) and today there remain only small remnant populations and occasional individual trees growing in other plant communities. We found sea-eagles nesting in surprisingly small remnants of forest (some pairs even nest in trees in pastures), but the need for more forest reserves, particularly those containing some *E. tereticornis*, is evident.

White-bellied Sea-Eagles usually build their nests in the taller trees, and generally 8–10 m below the top of the tree, although in our sample, one was located at the very top. The Bald Eagle (*Haliaeetus leucocephalus*) of North America is closely related to the White-bellied Sea-Eagle and a comparison of some of their nest site characteristics is of interest. A recent study of the Bald Eagle in Florida (McEwan and Hirth 1979) showed that of 18 nest trees all were *Pinus* (all 16 nest trees in our study were *Eucalyptus*), their average height was 26.3 m (compared to 27.8 m in our study), their average diameter at breast height was 0.6 m (1.1 m in our study) and the average height of nests was 22.4 m (ours was 18.9 m). Thus the average heights of the trees and of the nests were remarkably similar in the two studies. Further, while the height of the *Acacia* tree used in Africa by the Africa Fish Eagle (*Haliaeetus vocifer*) was not given by Brown and Hopcraft (1973), they mentioned that nests were about 20–30 m above the ground, once again similar to above data.

The diversity of habitats and of the types of trees used to support the nests suggest that sea-eagles attempt to build their nests in whatever is available provided they have ready access to a food source (mainly aquatic vertebrates) and provided their territory does not encroach upon that of another nesting pair. In areas which have little groundcover and which are easily accessible to man, human interference becomes a problem; although the sea-eagles may attempt to nest, they are unlikely to be successful (both of the nests in trees in pastures failed in 1979 and 1980). We are concerned that more than half (7 out of 13) of the nesting territories in our study is on private land. While most landholders are sympathetic toward the conservation of sea-eagles, economic pressures to clear the land for farming, for development or for timber will result in the destruction of some of these nesting habitats.

Acknowledgments

Our study of the White-bellied Sea-Eagle is continuing and we would be grateful for reports of possible nest sites in the Gippsland Lakes region. We thank C. M. Beardsell for his identifications of vegetation at the nest sites; D. D. Evans and F. I. Norman for their comments on drafts of the manuscript; A. Withers and R. Medling for their help in the field; and the many people who provided information on possible locations of sea-eagle territories.

References

- Brown, L. H. and J. B. O. Hopcraft. 1973. Population structure and dynamics in the African fish eagle *Haliaeetus vocifer* (Daudin) at Lake Naivaska, Kenya. *E. Afr. Wildl. J.* 11:255-269.
- Favaloro, N. 1944. The White-breasted Sea-Eagle along the Murray Valley. *Emu* 43:233-242.
- Fell, L. A. 1972. Ecology of some eucalypts of the Gippsland Lakes district. 100 years after Dr. Howitt. *Victorian Nat.* 89:320-325.
- McEwan, L. C. and D. H. Hirth. 1979. Southern Bald eagle productivity and nest site selection. *J. Wildl. Manage.* 43:585-594.

EGG LAYING IN A TWENTY-EIGHT YEAR OLD GOLDEN EAGLE

by

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Longevity of wild and captive birds of prey has been reviewed by Brown and Amadon (1968) and Newton (1979), but little or no mention is made of duration of reproductive capacity in raptors. The only information existing in avicultural literature is the suggestion that the captive Bald Eagle (*Haliaeetus leucocephalus*) should have a productive life span of 20 to 30 years (Hancock 1973). At what age do birds of prey cease to produce eggs or sperm?

In 1981, a tethered captive 28-year old Golden Eagle (*Aquila chrysaetos*), originally taken as a nestling in 1953 at Watson Lake, Yukon by F. Remmler, produced 2 eggs. This bird was held captive since 1973 at the Raptor Research facilities, McGill University, Montreal. It had apparently produced eggs previously, but the owner did not keep any records. No eggs were laid at McGill University until 1977, when the eagle was handled regularly by the junior author. Courtship behaviour towards people and subsequent egg-laying without a normal mate strongly suggests that this eagle was imprinted on man. The eggs were generally removed within 1 or 2 days of laying.

The pigmentation, length (mean = 7.33 cm) and breadth (mean = 5.32 cm) of eggs were quite uniform and similar to that reported for eggs of this species by Reed (1965) and Brown and Amadon (1968). Eggs were generally laid in the first 2 weeks of April. 4 in 1977, none in 1978, 2 in 1979, and 3 in 1980.

The longevity records summarized in Table 47, p. 367, by Newton (1979) indicate that some raptors can survive at least up to 26 years in the wild and up to 55 years in captivity. He further reported that eggs from an aging Peregrine Falcon (*Falco peregrinus*) tended to be smaller and paler than the normal. We have also observed this in a very old captive Red-tailed Hawk (*Buteo jamaicensis*). However, the role of old age in the potential reproductive output of any avian species will not be clearly understood until further information becomes available from both banding and captive breeding programs.

We are grateful to Réal Campeau for handling the eagle in 1980 and to Dr. Greselin of Ayerst-McKenna Ltd. for providing rats for food.

Literature Cited

- Brown, L., and D. Amadon. 1968. Eagles, hawks and falcons of the world. London: Country Life Books.
Hancock, D. 1973. Captive propagation of Bald Eagles—a review. *Int. Zoo. Yearb.* 13:244–249.
Newton, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, South Dakota.
Reed, C. 1965. North American birds eggs. Dover Publications, New York.

PORCUPINE QUILL AND BEETLES IN PEREGRINE CASTINGS, YUKON RIVER, ALASKA

by

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Many details regarding food habits of the Peregrine (*Falco peregrinus*) in interior Alaska are available. Prey have been identified by Osgood and Bishop (1900), Cade (1960), Cade et al. (1968), Enderson et al. (1972), and Ritchie (1979 unpubl. report to USFWS, Anchorage, Alaska). Traditionally these prey analyses have depended on species identification from uneaten parts.

In 1978 attempts to determine species consumed in dissected castings did not provide additional species identification. However, 2 items of interest did emerge from their dissection. First, insect parts, mainly elytra and disarticulated body parts, were found in 14% of the castings. Three species were identified including a long-horned beetle (family Cerambycidae), leaf beetle (*Calligrapha serpentina*), and a ground beetle (*Colosoma scrutator*). The latter is a ravenous carnivore (Lindroth 1969) and probably common at decaying prey near eyries. The other two are foliage and tissue feeders of plants (Borror and White 1970) but could easily be found in or adjacent to a perch or eyrie. These families have not been observed commonly in raptor nests, (Philips and Dindal 1977) and may represent prey of insectivorous birds eaten by Peregrine Falcons. Other data for Peregrine prey in Alaska do not include insects (Sherrod 1978). However, Bent (1950) and Fisher (1993) recorded beetles in the diet of peregrines. Snyder and Wiley (1976) determined that invertebrates represented 19.8% of all items in a sample of peregrine stomachs and grasshoppers and cicadas were recorded in food of Australian Peregrines (Pruett-Jones, et al., 1981).

Second, the quill of a porcupine (*Erethizon dorsatum*) was painfully discovered in a casting. Porcupines have been identified in the diet of large raptors, such as the Golden Eagle (*Aquila chrysaetos*) (Olendorf 1976), but it is doubtful that Peregrines would pursue even a young porcupine. An accidental confrontation might explain its origin. Quills found in the foot of a Sharp-shinned Hawk (*Accipiter striatus*) probably occurred this way (Kelley and Kelley 1969). It is more likely, however, that this quill was acquired by the Peregrine in some indirect manner: (1) the quill was imbedded in a prey species which may have fed on porcupine carrion (e.g., Gray Jay [*Perisoreus canadensis*]); or (2) the quill was already in the eyrie and adhered to prey eaten at the nest.

The second speculation seems plausible since porcupines in interior Alaska are often observed on cliff areas used by Peregrines. They probably seek out overhangs and ledges associated with these cliffs for shelter (Vaughan 1972). More accessible eyries would provide temporary shelters. Porcupine scat has been observed in close proximity to Yukon River eyries. External injury by quills would be quite obvious (Kelley and Kelley 1969). Internal damage might be more significant and affect the bird long after ingestion.

These results suggest casting dissection should complement food studies based primarily on species identification from uneaten parts. It is a useful tool in the determination of unusual and often overlooked items ingested by raptors.

Robert "Skip" Ambrose and James A. Curatolo helped collect specimens. Data were gathered under contract with the USFWS, Anchorage, Alaska. Dr. Richard Werner, Research Entomologist, Institute of Northern Forestry, Fairbanks, assisted with beetle identification.

Literature Cited

- Bent, A. 1938. Life histories of North American birds of prey, order Falconiformes. Part 2. U.S. Natl. Mus. Bull. 170. Dover Publications, New York.
- Borror, D. J., and R. E. White. 1970. A field guide to the insects of America north of Mexico. Houghton-Mifflin, Boston.
- Cade, T. J. 1960. Ecology of the peregrine and gyrfalcon populations in Alaska. Univ. of Calif. *Publ. in Zool.* 63:151-267.
- Cade, T. J., C. M. White, and J. R. Haugh. 1968. Peregrines and pesticides in Alaska. *Condor* 70:170-178.
- Enderson, J. H., S. A. Temple, and L. G. Swartz. 1972. Time-lapse photographic records of nesting Peregrine Falcons. *Living Bird* 11:112-128.
- Fisher, A. K. 1893. Hawks and owls of the United States and their relation to agriculture. U.S. Dept. of Agric. Bull. 3 Govt. Printing Office, Washington, D.C.
- Kelley, A., and N. Kelley. 1969. Porcupine quills found in the foot of Sharp-shinned hawk. *Wilson Bull.* 81:209-210.
- Lindroth, C. H. 1969. The ground beetles of Canada and Alaska. *Opuscula entomologica. Suppl.* 20, 24, 29, 33-35. 1192 p.
- Olendorf, R. 1976. Food habits of North American Golden eagles. *Amer. Midland Nat.* 95:231-236.
- Osgood, W., and B. Bishop. 1900. Results of a biological reconnaissance of the Yukon River. North American Fauna No. 19, U.S. Dept. of Agric. Div. Biol. Survey. 100 pp.
- Philips, J. R., and D. L. Dindal. 1977. Raptor nests as a habitat for invertebrates: A review. *Raptor Res.* 11:87-96.
- Pruett-Jones, S. G., C. M. White and W. R. Devine. 1981. Breeding of the Peregrine falcon in Victoria, Australia. *Emu* 80:252-269.
- Sherrod, S. K. 1978. Diets of North American Falconiformes. *Raptor Res.* 12:49-121.
- Snyder, N. F., and J. W. Wiley. 1976. Sexual size dimorphism in hawks and owls of North America. AOU Ornithol. Monogr. 20.
- Vaughan, T. A. 1972. Mammalogy. W. B. Saunders Co. 463 pp.

AN ENCOUNTER BETWEEN A NESTING BARN OWL AND A GRAY RAT SNAKE

by

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On 20 April 1981 at 1700 we climbed to the top of an abandoned concrete silo in Oktibbeha Co., Miss., to measure a brood of 4 Barn Owls (*Tyto alba*) which ranged in age from 8 to 16 days old. The silo was constructed of poured concrete and had smooth sides with a few Virginia creeper (*Parthenocissus quinquefolia*) vines growing the 12 m to the "room" just below the broken cone-shaped concrete top. Our access to the top was by way of a series of metal rungs built into a concrete tube leading vertically to the top. Each day one or both adult Barn Owls flew as the first person started up the ladder; this date one owl flew. At the top, we found the 4 young owls in their normal position against the back wall of the 3.5 m diameter chamber; stretched out along the opposite wall was a large gray rat snake (*Elaphe obsoleta spiloides*). The snake pulled its head back and raised it slightly as we entered the chamber, but remained motionless 2 m away (for about 5 min) as we weighed and measured each owlet. When finished we climbed from the chamber to a point where we could just peer over the edge to view owls and snake. After 4 min, the snake began slowly moving toward the 4 owlets that had meantime settled back into "huddled" positions—2 groups of 1 large and 1 small chick. The snake moved along the edge of the wall to within 0.3 m of the closest owls before we climbed into the chamber to stop its advance. The owlets noticed the snake, but appeared to view it with curiosity rather than with fear. They huddled together but did not retreat as the snake approached.

On examining the snake, we found fresh puncture wounds on the head and in two other areas within 15 cm of the head; these were clearly talon marks. We can only speculate about what occurred just prior to our appearance on the scene. From all appearances, the rat snake had climbed the silo to the owl nest and was attacked by the owl when about 3 m from the nest.

The rat snake was 151 cm long (snout vent length—134 cm) and weighed 772 g. For comparison, two adult male Barn Owls from Oktibbeha County in the ornithological collection at Mississippi State University weighed 492 and 512 g. The Barn Owl chicks in this nest weighed from 76.3 to 302 g.

The gray rat snake is well-known as a climber and predator on nestling birds (Jackson 1974, 1976). Perusal of bibliographic entries for the Barn Owl in Clark et al. (1978), and a review of the Barn Owl in Bent (1938), revealed no reference to snakes as prey of Barn Owls, Barn Owls as prey of snakes, or nest defense by Barn Owls against a snake. Thus, the incident reported here, however interpreted, seems to be unusual.

Literature Cited

- Bent, A. C. 1938. Life histories of North American birds of prey. Part 2. U.S. Natl. Mus. Bull. 170.
Clark, R. J., D. C. Smith, and L. H. Kelso. 1978. Working bibliography of owls of the world. Sci. and Tech. Ser. 1, Natl. Wildl. Fed., Washington, D.C.
Jackson, J. A. 1974. Gray rat snakes versus Red-cockaded woodpeckers: predator-prey adaptations. *Auk* 91:342-347.
Jackson, J. A. 1976. Relative climbing tendencies of gray (*Elaphe obsoleta spiloides*) and black rat snakes (*E. o. obsoleta*). *Herpetologica* 32:359-361.

INNATE FISHING BEHAVIOR OF OSPREYS

by

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The literature contains much controversy regarding the innate fishing abilities of the Osprey (*Pandion haliaetus*). Zarn (1974) noted little documentation exists for post-fledging activity of young Ospreys. Meinertzhagen (1954) anthropomorphically described attempts by adult Ospreys in Sweden to teach young to fish, and D. S. MacCarter (1972) stated that Ospreys at Flathead Lake appeared to teach young to fish, but questioned the validity of his own conclusions. Bent (1937) and Craighead and Craighead (1939) both stated that fishing behavior is innate and that Ospreys do not teach their young to fish. This area of Osprey life history clearly needs clarification.

Brown and Amadon (1968) hypothesized that young raptors possess innate hunting instincts that stimulate hunting behavior even while food is being provided by adults. This hypothesis is supported by observations made on young of the Peregrine Falcon (*Falco peregrinus*). Nestling Peregrines released to the wild through a "hacking" procedure learned to kill their own food in 4 to 6 weeks after leaving the nest (Sherrod and Cade, 1979). The Bald Eagle (*Haliaeetus leucocephalus*) hacked in a similar manner also demonstrated ability to seek and kill prey independently (Milburn, 1979). Hacking of Ospreys as a species management technique is obviously dependent on the theory of innate hunting instincts in young birds during the post-fledging period.

Research concerned with developing reintroduction techniques to reestablish inland nesting populations of Ospreys in favorable habitats further supports this theory. During the summer of 1980, 6 nestling Ospreys were obtained from nest-sites in the Chesapeake Bay and transferred to the Wild Creek Reservoir complex in northeastern Pennsylvania. The six-week-old donor birds were placed in artificial nests on hacking towers and fed by workers through a blind, minimizing the possibility of the birds relating human presence to food supply. The birds were fed in this manner until they fledged in late July.

As the Ospreys began returning regularly to the towers to feed, the instinctive development of fishing behavior became apparent. They, however, displayed markedly different patterns of post-fledging behavior. Three birds, Group A, gained independence of nest platforms within 5 to 12 days and perched on specific snags to hunt, whereas Group B continued to use the nest platforms to perch and feed until they dispersed in

late August. The 2 groups also displayed marked differences in fish catching ability (Table I). All birds were observed fishing successfully on at least 1 occasion, and 1 bird that began fishing immediately, was successful on 8 observed occasions, including the second and third day after fledging. Hammer (pers. comm.) also observed hacked Ospreys fishing instinctively in Tennessee.

Table I. Platform dependence time, fishing attempts and success percentages for post-fledging Ospreys hacked in Pennsylvania in 1980.

OBSERVATIONS	GROUP A			GROUP B		
	GREY	BLUE	WHITE	YELLOW	RED	GREEN
Platform Dependence Time (days after fledging)	8	12	5*°	25°	15°	19°
Dives	15	2	6	8	7	4
Successes	8	1	1	1	1	2
Percent of Fishing Success (per bird)	53.3	50.0	16.7	12.5	14.3	50.0
Percent of Fishing Success (per group)	23 dives 10 successes		43.4	19 dives 4 successes		21.1
Percent of Fishing Success (overall)		42 dives 14 successes		33.3		

*at dispersal

°found deceased

Although the sample size is small, the data clearly demonstrates that fishing behavior is innate in Ospreys and that young can be successful hunters without the "teaching" benefits of parent birds.

Literature Cited

- Bent, A. G. 1937. Life histories of North American birds of prey, Order Falconiformes. Part 1. U.S. Natl. Mus. Bull. 167 pp.
- Brown, L. H., and Amadon, D. 1968. Eagles, hawks, and falcons of the world. 2 vols. McGraw-Hill, New York. 945 pp.
- Craighead, F., and J. Craighead. 1939. Hawks in the hand. Houghton Mifflin, Boston. 290 pp.
- MacCarter, D. S. 1972. Food habits of Ospreys at Flathead Lake, Montana. M.S. Thesis, Humboldt State College. Arcata, Calif. 80 pp.
- Meinertzhagen, R. 1954. The education of young Ospreys. *Ibis* 96:153-155.
- Milburn, E. H. 1979. An evaluation of the hacking technique for establishing Bald Eagles (*Haliaeetus leucocephalus*). M.S. Thesis. Cornell University. Ithaca, N.Y. 184 pp.
- Sherrod, S. K. and T. J. Cade. 1978. Release of Peregrine Falcons by hacking. Pages 121-136. In T. G. Geer, ed., Birds of Prey Management Techniques. British Falconers' Club.
- Zarn, N. 1974. Osprey (*Pandion haliaetus carolinensis*). Tech. Note No. 254. U.S. Bureau of Land Management, Denver Service Center, Denver Colorado.

SPRIG COLLECTION BY A BROAD-WINGED HAWK

by

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Burns (Wilson Bull. 23:139-320, 1911) states that the Broad-winged Hawk (*Buteo platypterus*) breaks sprigs of fresh greenery to be used as nest material from the tops of trees. No description of Broad-winged Hawk sprig collection behavior exists in the literature. Olendorff (Raptor Res. Repts. No. 1., Part 1, 1971) indicates which raptors collect sprigs but there are few descriptions of collection of material by raptors. I observed an adult Broad-wing collecting sprigs for a nest in a trembling aspen (*Populus tremuloides*) in Lincoln County, Wisconsin in 1980. Observations of the bird were made from a blind placed 7.5 m horizontally from and 1 m above its nest. The same adult Broad-wing was observed making 5 sprig-breaking attempts (three on 22 June, two on 6 July), all in trees about 15 m from the nest. Three attempts were successful, resulting in the collection of 1 sprig from a white birch (*Betula papyrifera*), a trembling aspen, and a red maple (*Acer rubrum*). Prior to two successful collections, the adult attempted unsuccessfully to collect a sprig; once in the nest tree, after which it flew to the birch, and once in the aspen. All collection attempts occurred in the lower halves (4-7 m above ground) of trees. The sequence of collection behavior usually occurred as follows: (1) the hawk flew from the nest to a branch; (2) stepped close to the selected sprig which was always part of the branch on which the hawk was standing; (3) extended its forebody while its feet remained stationary; (4) grasped the sprig near its base with the beak, and (5) tugged while simultaneously flapping until the sprig came free. The sprig was held in the beak and carried to the nest. This behavior is similar to that described for a Goshawk (*Accipiter gentilis*) by Schnell (Condor 60:377-403, 1958), but differs in that the Broad-wing flapped its wings while simultaneously tugging; Schnell reported that flapping followed each tug. Ellis (Wildl. Monogr. 70:94pp, 1979) reported that Golden Eagles (*Aquila chrysaetos*) flapped their wings while gathering nesting materials but he did not specify when the flapping occurred. I suggest that the flapping by this Broad-wing not only helped maintain balance, as suggested by Schnell (1958), but also provided additional "pulling power."

I thank R. Anderson, M. Fuller, and my fellow graduate students for suggestions on this note.

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